INSTRUCTIONS

for

INSTALLATION and MAINTENANCE

of

HEWITTIC RECTIFIERS

LARGE SINGLE BULB CUBICLES
(Type S.T.)

CONTENTS

HACKBRIDGE AND HEWITTIC ELECTRIC CO., LTD.
WALTON-ON-THAMES . SURREY . ENGLAND

Telephone : Walton-on-Thames 760 (8 lines)
Telegrams : Electric, Walton-on-Thames

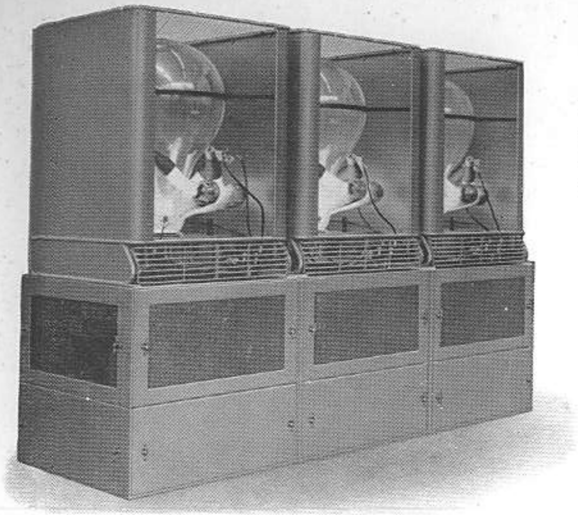


Fig. 1. A bank of Hewittic type ST rectifiers. The sheeting on the cradles has been removed to show bulbs.

LINING UP THE CUBICLES

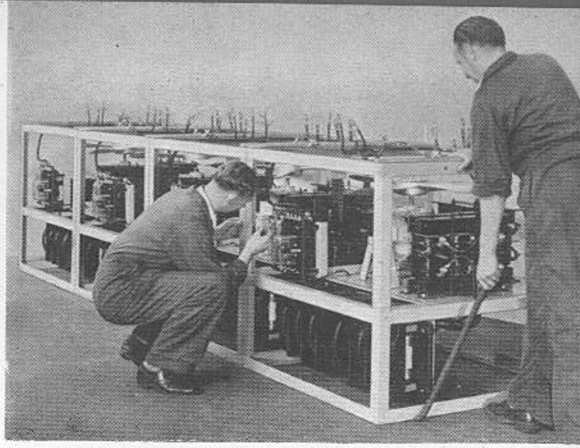
Rectifier units for Great Britain are usually delivered to site on the Company's own vehicles : equipments for overseas orders of course are suitably crated for shipping. The bulbs are always despatched in individual cases as described later.

Lifting gear is not necessary (assuming the plant to be installed at ground level), although if a mobile or other crane is available some time may be saved by its use. The cubicle bases are easily positioned by means of a couple of rollers and a pinch bar, as shown in Fig. 2. The floor should be reasonably level, the weight being borne mainly at the corners of the cubicles. Should there be any gaps at these points, suitable wedges or shims should be used and the floor grouted in to give a finished appearance to the job.

As there is no vibration in use, floor bolts are not essential, but a few may be used if desired. Bolts, however, are provided for insertion in the adjacent uprights, for pulling together the cubicles and forming a rigid bank.

Apart from detaching the connections between the base unit and the bulb cradles, and any jumper cables

Fig. 2. Lining up the cubicle bases and bolting together.



between adjacent units, nothing is removed or detached after the test run. It is necessary, therefore, merely to restore any such jumper cables (which will be suitably identified by engraved ferrules) and then to complete the external cabling in accordance with the working drawings supplied.

This work should be checked over, and the equipment cleaned down if necessary, before proceeding to install the bulbs.

INSTALLATION OF THE BULBS

Before proceeding to handle the bulbs please read through these instructions carefully. Remember that it is impossible to refer to them whilst carrying a rectifier bulb!

It is advisable to clear the floor of all tools and scrap lengths of cable before bringing the bulbs to the vicinity of the cubicles, so that erectors do not stumble while handling the bulbs.

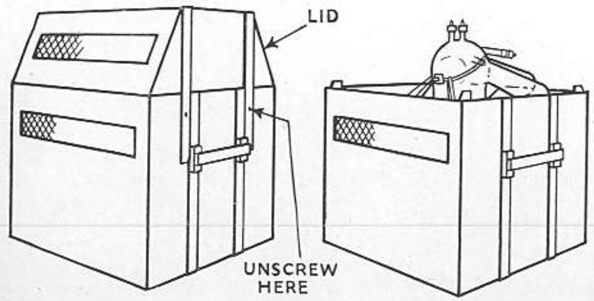


Fig. 3. Showing the method of opening a bulb case.

REMOVAL OF BULBS FROM CASES

The bulb, which is a sealed glass vessel exhausted to a high degree of vacuum and containing heavy, liquid mercury, is shipped in a specially sprung case provided with wire gauze windows so that the contents may be clearly seen from the outside. The bulb is carried in a sling and is secured in position by means of spring straps. It is shipped upside down, with the mercury in the domed part of the bulb, i.e. the condensing chamber.

To unpack a bulb, unscrew the wood screws on all four battens (see Fig. 3), remove the lid (do not attempt to dismantle the case) and unfasten the spring straps. Then lift the bulb clear of its harness by holding it under the bulb arms.

Fig. 4. Lifting a bulb from the case.

It will be found easiest if this part of the operation is performed by two men at adjacent sides of the crate (see Fig. 4).

Mind the Seal-off ! The seal-off, covered by a small black cap, is situated towards the end of the lower part of one main anode arm. Care should be taken not to strain this point and, particularly when turning the bulb, mercury should not be allowed to enter this arm violently. If the bulb is handled as described below, only the minimum amount of mercury will enter the anode arms.

Turning Bulb into the Upright Position. Having lifted the bulb clear of the case, turn it slowly into the upright position, i.e. with the cathode stems pointing downwards, as shown in the photographs. The mercury must be prevented from pouring into the base of the bulb or any of the arms with too much violence.

Fig. 5. Turning the bulb into the upright position, the mercury being allowed to run gently down the side into the cathode chamber. (Note arm with seal-off is at the top).

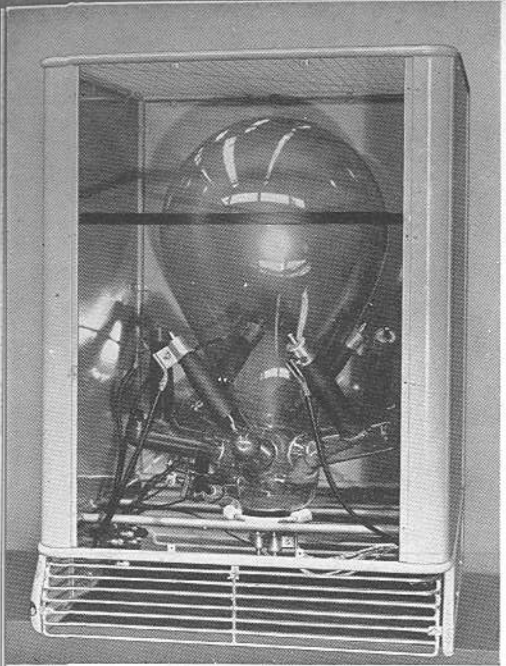


Fig. 6. Showing the bulb correctly placed in its cradle, the starting electrode to the left-hand side.

PLACING THE BULBS IN THE CRADLE AND CONNECTING UP

Fig. 6 is a photograph of a cradle with the bulb in position. The bulb is seated on a padded supporting ring, and secured by an asbestos-lined flexible steel band that clips round the bulb at its widest part. The cathode stems pass through this base ring, and the connecting clips are attached from underneath. Similar clips are fitted to the main and auxiliary anodes. The bulb should be seated with the starting electrode located to the left of the cradle. If it is found necessary to rotate a bulb after it has been placed in position, one man should release the spring band while the other lifts and rotates the bulb to its correct position.

Removal of Grease from Bulb Terminals. The terminal caps are protected from corrosion by a film of grease. This should be removed by means of a clean rag but the cap must not be gripped and twisted as this might damage the seal ; use a gentle movement from the extremity of the arm downwards.

Fitting the Bulb Clips. Each clip should be well loosened before it is slid on to the terminal cap ; the

ears should then be pinched together with the finger and thumb of one hand while the knurled nut is followed up with the other. The lock-nut is then tightened against it. Under no circumstances should pliers or a spanner be used—tightening by hand will give ample contact pressure and will ensure that no damage is caused by excessive tightness.

Tension of Leads. The amount of slackness in each flexible lead can be adjusted by rotating the electrode clip before tightening. All leads should be adjusted in this way in order to ensure that no stress is placed upon the bulb. Take care that there is an adequate clearance to earth from the clip and any bare portion of the lead thereto.

If, after connecting up, it is found that a connecting clip needs to be rotated slightly in order to adjust a flexible lead, it should always be loosened completely first, as any attempt to rotate whilst it is still gripping the cap may damage the seal.

Fitting the Starting Coils. With this type of bulb two starting coils are fitted. Their position is illustrated in Fig. 8. It will be seen that there is a thicker section on the starting arm at the point where the two starting coils are clamped.

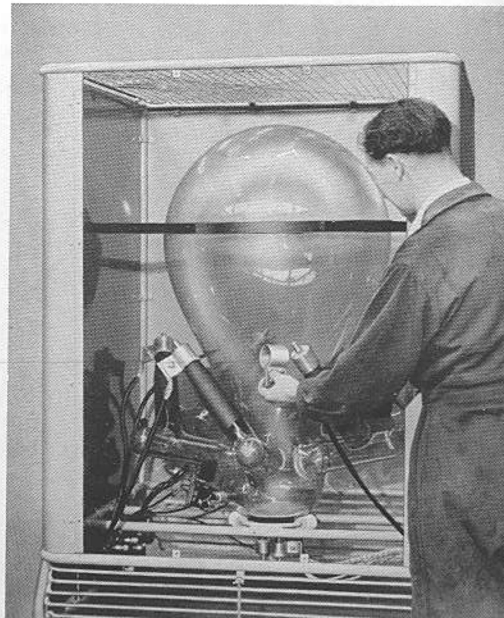


Fig. 7. Fitting the bulb clips. A finger-tight grip is all that is required.

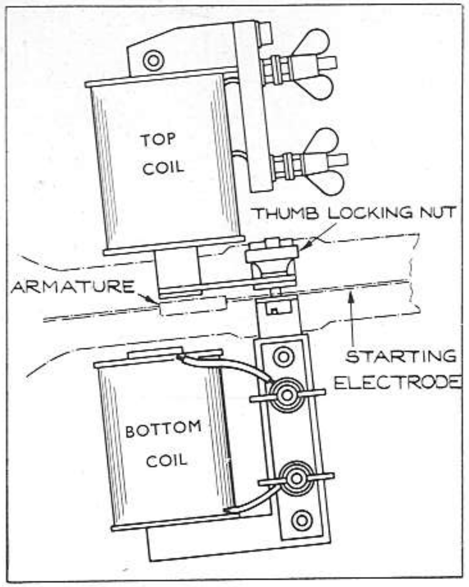


Fig. 8. Showing the arrangement of the starting coils on the starting arm.

At this point, inside the arm, the flexible stem of the starting electrode is fitted with a soft iron armature, which is attracted by the starting coils when they are energised in turn. The starting coils should be adjusted so that this armature comes between the two pole pieces of the lower coil and under the single pole piece of the upper coil. This arrangement will give the maximum pull in both directions.

With the double starting coil, the position of the tip of the starting electrode is not critical but it should be between $\frac{1}{8}$ in. below the level of the mercury and $\frac{1}{4}$ in. above it when the bulb is correctly seated.

MOUNTING THE CRADLE ON THE CUBICLE BASE

When all of the main and auxiliary connections to the bulb have been made and the starting coils fitted, the cradle is ready for placing on the cubicle base. This operation can be carried out by two men although a

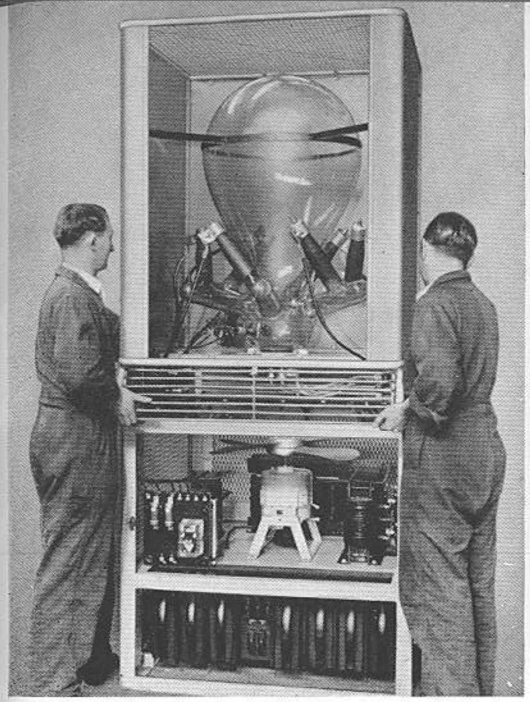


Fig. 9. A cradle complete with bulb being slid on to the rectifier base.

Fig. 10. Connecting the main and auxiliary leads to the cradle terminal boards.

third may be helpful in guiding it into the guide channels. The cradle is pushed to the end of the channels and then clamped down to the base by means of small thumbscrews. The earth connection fitted to the top of the base requires bolting to its terminal on the cradle.

It will be necessary to remove the detachable grille on the front of the cradle to enable the leads from the base unit to be connected to the terminals on the cradle. Each auxiliary lead carries an engraved ferrule for identification, and connects with a terminal stud bearing a similar marking. The markings for the main anode connections are stamped on the lugs; the cathode connection is self-evident.

When starting up for the first time, the front sheet may be left off if desired, for the better examination of the striking up of the bulb and for observing the steady running on the exciters. Once this is assured, the sheet should be fitted to complete the ventilation system and also to protect the bulb from possible damage.

THE GENERAL PRINCIPLE OF THE MERCURY VAPOUR RECTIFIER

The mercury arc rectifier consists essentially of a highly evacuated vessel containing a mercury pool known as the cathode, and a number of electrodes known as anodes which are sealed into the arms forming part of this vessel. These anodes are usually made of graphite.

Its principle of operation depends upon the fact that, under suitable conditions, a stream of electrons can be drawn from the surface of the mercury towards the anodes, whereas under the same conditions there is no such flow from the anodes to the mercury pool.

The conditions referred to are that the vessel must be evacuated to a very high degree of vacuum, that a " hot-spot " must be created and maintained on the mercury pool, and that the rectifier must be maintained within certain limits of temperature. (See " Operating Temperature ".)

The " hot-spot " is initiated by drawing a small arc between a starting electrode and the surface of the mercury. This is just a momentary arc because immediately this " hot-spot " is created, there is a source of free electrons which enables the exciter anodes to strike up. These anodes are connected to the secondary winding of the single phase exciter transformer which gives an open-circuit voltage of 70 volts from either anode to the mid-point of the winding. (65 volts in the case of types 300 and 350 bulbs).

It will be seen that the exciter anodes are alternately at a positive potential to this mid-point, and therefore to the mercury pool which is connected thereto. As each anode becomes positive, a stream of electrons is drawn to it and passes round the circuit external to the bulb. This constitutes an electric current identical with the current generated by a machine or circulated by a battery. The two anodes, conducting alternately constitute a small rectifier, as the pulses of current from the cathode to the mid-point of the transformer are all in the same direction.

The early conception of an electric circuit, viz., that the current flowed from the positive pole of a battery or generator, through the external circuit to the negative pole, clashes with the modern electron theory.

Within the rectifier the electron stream is necessarily described as flowing from the cathode to the anodes. Externally, however, the current is spoken of as flowing from the cathode, via the load circuit to the mid-point of the transformer, which is always the negative terminal of a rectifier using this type of connection.

If an alternating potential is applied to the main anodes, and there is a complete external circuit, then there will be a similar electron stream to those anodes. Each anode conducts until the potential on the one in the succeeding phase reaches and exceeds its own falling potential, and thus the stream, or arc, transfers from anode to anode in synchronism with the altenations of the source of supply. In consequence of the retentivity of vision, all of the arms of a glass bulb type of rectifier appear to be conducting simultaneously, when operating on a 50 or 60 cycle supply.

It was stated earlier that a high degree of vacuum must be maintained in the rectifier. The Hewittic air-cooled glass bulb is a permanently evacuated vessel which does not need pumps and gauges for maintaining and checking the vacuum once the bulb is made and sealed, and since there is no consumption of either the mercury or the electrodes, it follows that the bulbs will run for an indefinite period without maintenance.

If the bulb is overloaded much beyond the combination of time and current specified as the overload capacity, then the anodes will reach such a temperature that they become capable of emitting electrons under the stress of the reverse voltage. This constitutes a " backfire " and may result in the blowing of a number of anode fuses. Also the associated D.C. circuit breaker is liable to trip on reverse current, assuming that there is a possible feed back from some external source.

Similarly, if the fan should fail at any time while the

bulbs are carrying more than about a third of the rated load, condensation would not keep pace with the vaporisation of the mercury from the pool. The vapour pressure in the bulb would thus increase and this could reach a point where a " backfire " might occur. The fans, however, are always driven by simple 3 phase squirrel cage motors of a very robust type, and failures are almost unknown.

At the other end of the temperature scale, there is the possibility of some surging if load is suddenly applied to a rectifier while the bulb is very cold. This can cause momentary high voltages from the transformer and other inductive coils. To prevent damage to insulation, surge divertors are fitted between the outer ends of each phase, and the outgoing or load side of the interphase transformer and fan choke (where the latter is fitted). The fan choke ensures that below about a quarter of full load the fan merely crawls thus avoiding unnecessary cooling.

Starting and Maintaining Circuits

The full starting and excitation circuits are given in Fig. 14, but starting will be more readily understood from the simplified diagrams shown in Figs. 11, 12 and 13. These deal with this operation in three stages. In actual practice it happens so quickly that the eye cannot follow what takes place : the supply is switched on, and, to the accompaniment of the click of the starting relay, the bulb is " running on the exciters ".

Stage 1. The exciter transformer gives an open circuit voltage of 65 or 70 volts from either 1 or 3 to the mid-point 2. (See Fig. 13). Immediately this is energised, current flows via contact 3 of the exciter relay, through the protective resistor, R, to the lower starting coil 5.7, through the second contact of the relay (7.8) and the coil fuse (when fitted) to 2.

The starting electrode is immediately pulled into contact with the cathode pool. It will be seen that such contact constitutes a short circuit across this lower coil so that practically the whole of the voltage drop in this circuit now occurs across the resistor.

Stage 2. The top starting coil being in parallel with the resistor now receives sufficient current to pull the starting electrode from the mercury pool. This draws a small arc from the surface of the mercury.

Stage 3. The free electrons resulting from this arc enable the exciter electrodes to strike up and remain energised. It will be seen from the diagram, Fig. 13, that the circuits to the exciter anodes pass through the coils of the starting relay, as well as the exciter chokes. As soon as the bulb is running on the exciters the relay operates, and isolates the starting coils and the starting electrode. This usually happens too quickly to be observed and is the normal running condition the whole time that the rectifier is in service.

On the full wiring diagram (Fig. 14) will be seen a set of surge divertors connected across the exciter chokes and transformer. These serve a similar purpose to those connected to the main anode circuits.

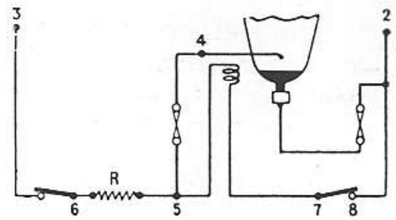


Fig. 11. Energising the lower starting coil.

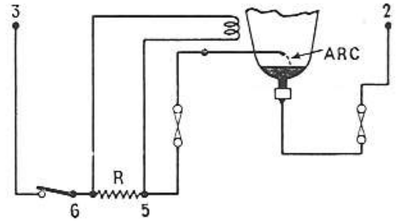


Fig. 12. Energising the upper starting coil.

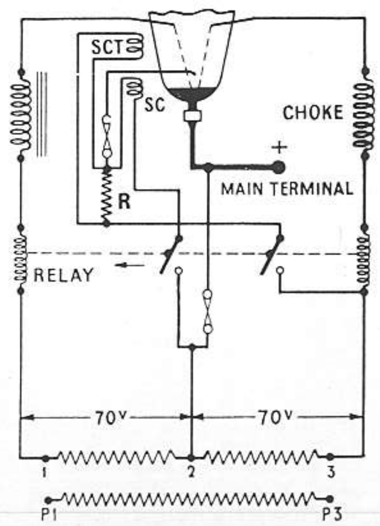


Fig. 13. Complete exciter circuit (running condition).

N.B.—Type Wx relay differs from type W in that it has an additional pair of normally open contacts. These can be used to give a remote indication that a bulb has not struck up with the rest, or for control purposes.

The value of the current circulation in the exciter circuit is governed by the exciter choke, and this is correctly adjusted whilst in the Test Department. The load is mainly inductive and the energy consumption for the largest bulbs is only about 200 to 250 watts.

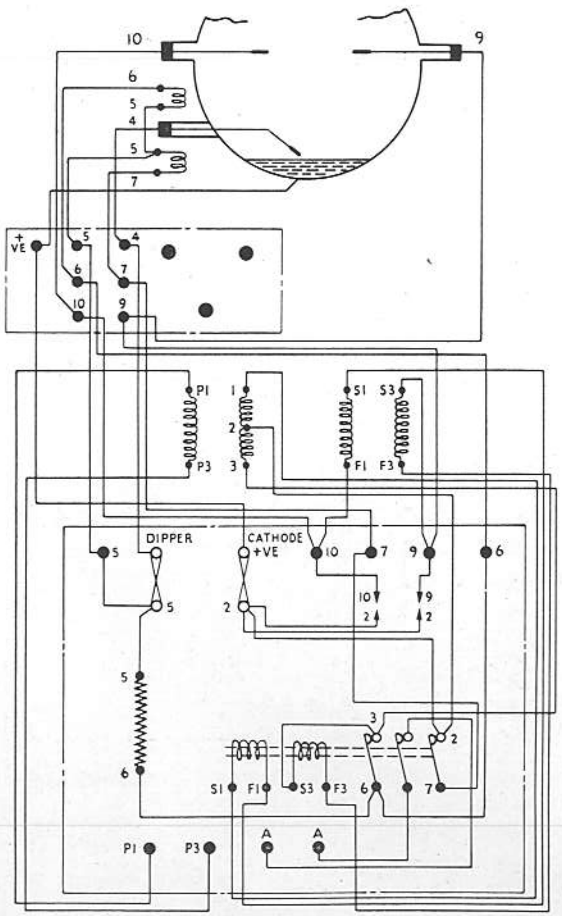


Fig. 14. Diagram of exciter connections.

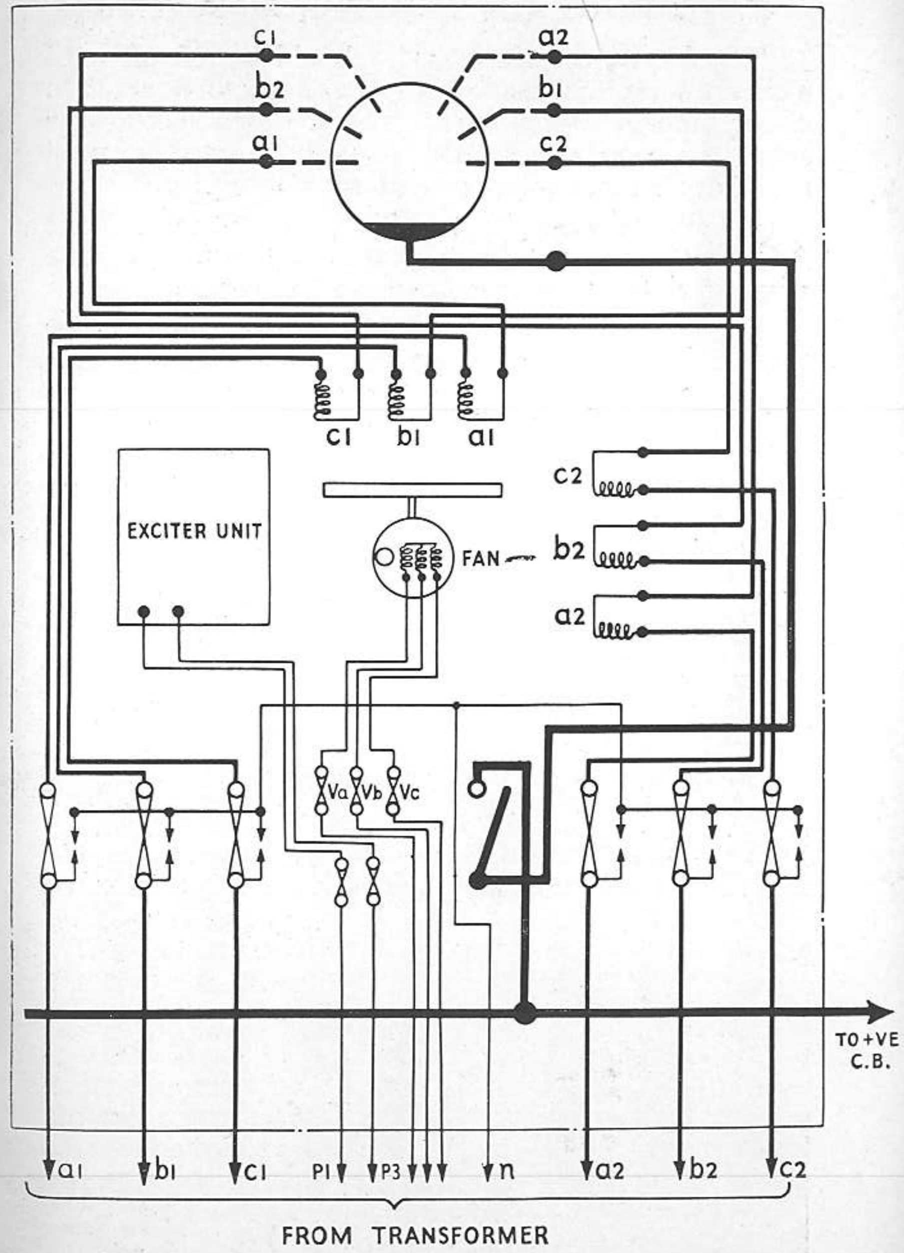


Fig. 15. Main wiring diagram for a typical single bulb cubicle.

SWITCHING ON FOR THE FIRST TIME

The front sheet of the cradle should be left off until a trial run has been made to ensure satisfactory operation of the bulb on its exciters. The D.C. circuit breaker should be kept open so that no load is picked up until the above trial run has proved satisfactory.

Where possible it is advisable to put the trips of the A.C. switchgear on a light instantaneous setting in case a wrong connection or unobserved fault exists.

Upon energising the main transformer it is usual for the bulb to strike up almost instantaneously and remain running steadily on the exciter arcs. Should the bulb re-strike a few times, this does not necessarily indicate that something is wrong: it may be due to low ambient temperature. If this re-striking persists, it would be advisable to check that the voltage is not unduly low. The exciter transformer should give 70 volts from either terminal 1 or 3 to the mid-point 2 on open circuit. If this is low, then either the main transformer is on a plus tap or the supply pressure is below the declared pressure. In either case, a change of transformer tap will remedy this trouble. (Note: the taps being in the primary side of the transformer it is necessary to change to a *lower* tapping to *increase* the secondary volts).

Checking Exciter Current. If running on the exciters is still unsteady it is advisable to check the

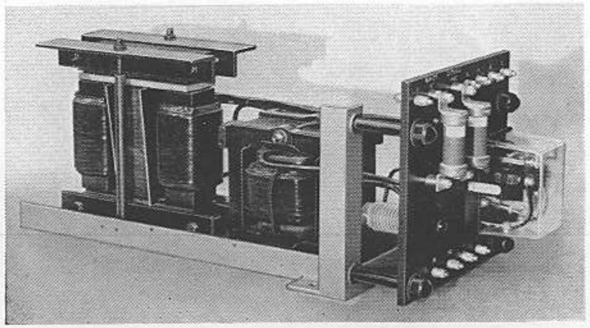


Fig. 16. A general view of the removable exciter unit.

current. This is always done in the cathode connection, where the flow of current is continuous, whereas in the anode leads it is a succession of intermittent pulses, being neither alternating current nor continuous current.

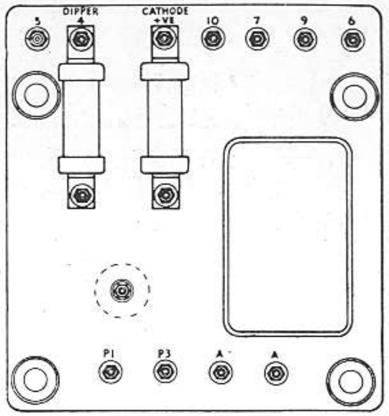


Fig. 17. Showing markings and location of components on the terminal panel of the exciter unit.

Remove the cathode fuse from the exciter panel and connect a moving coil ammeter across these terminals. The correct excitation current is given in the following table:—

Bulb type number	Using fan choke	Without fan choke	Exciter volts
300	6.6–7.0 Amps	7.0–7.4 Amps	65–0–65
350	7.0–7.4	7.4–7.8	65–0–65
400	7.4–7.8	7.8–8.2	70–0–70
500 & 550	7.8–8.2	8.2–8.6	70–0–70
600	8.2–8.6	8.6–9.0	70–0–70

To increase the current the gap in the laminated core of the exciter choke must be increased. Loosen the clamping bolts and add about $\frac{1}{16}$ in. of presspahn or similar material to the packing already there. Tighten the clamps before making a further test and see that they are thoroughly tight upon completion as otherwise the choke may become noisy. Fig. 16 gives a general view of the exciter unit: the packing under the top yoke of the choke is distinctly seen.

Checking Phase Sequence. When a rectifier plant is switched on for the first time the direction of rotation of the fan must be checked: it should be clockwise when looking down on the blades, so as to blow air upwards to the bulbs. Test the draught by hand, as, due to stroboscopic effect it will, at certain speeds, appear to be rotating in the opposite direction.

Should the rotation be incorrect it will most likely be

the result of the primary connections to the transformer being non-standard, since the fan connections are not disturbed once the cubicle passes out of the test room.

With non-grid controlled rectifiers, phase sequence is of no consequence and correction could be made by changing over two leads of the fan. This, however, is not recommended as it may lead to complications, or even a severe short circuit, should A.C. extensions and interconnections be made at a later date.

In the case of grid controlled rectifiers it is imperative that phase rotation be correct. The fan, *connected as despatched from the works*, would serve as a reliable phase sequence indicator.

SWITCHING ON NORMALLY

Equipments comprising more than one cubicle should be switched on with the D.C. circuit breaker open so that should any of the bulbs be sluggish at striking up,

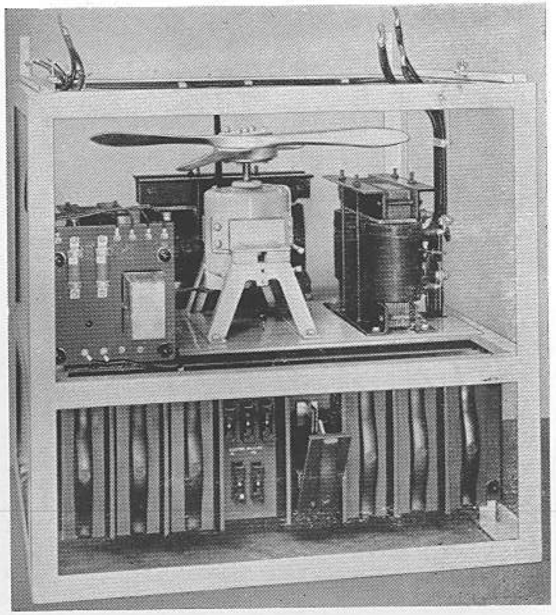


Fig. 18. A view of the base showing the main and auxiliary isolation features. (Cathode isolator partly withdrawn).

the load will not be picked up by only a portion of the rectifier. As soon as it is confirmed that all of the bulbs are steadily running on the exciters the circuit breaker may be closed and it is a good plan to check by observation that the bulbs are each taking approximately the same load. At the same time, when a fan choke is incorporated it should be checked that the fans are going at about the same speed and, if the load is fluctuating, that they come up to full speed at approximately the same time, usually at about half load.

It should be noted that at very light loads the fan speed is dependent on bearing friction only and some may be stopped while others rotate very slowly. This does not matter.

OPERATING TEMPERATURE

The rectifier operates most satisfactorily in an ambient temperature between 10° and 30°C (50-86°F). Higher temperatures are permissible when an allowance is made for this in the original design of the plant.

Glass bulb rectifiers are less susceptible to low temperature than other types and, if not fitted with grids, may be operated down to 5°C (41°F). When fitted with grids for voltage control, however, they must be maintained at a temperature above 10°C if erratic operation and possible damage to the plant are to be avoided; THIS IS MOST IMPORTANT.

Therefore, whenever a grid controlled rectifier is installed in a location which may be subject to low temperature, artificial means should be used to maintain the bulbs at a temperature not less than 10°C, both prior to starting and during operation. Where considered necessary thermostatically controlled heaters can be built into the cubicles during manufacture in the Works. This dispels any anxiety on the point and also is far more economical than keeping the whole of an unattended substation warm throughout the winter months.

ISOLATION FEATURES

Where an equipment comprises a number of cubicles, facilities are usually provided for isolating any one of the cubicles without interrupting supply from the remainder. (Care must be taken to ensure that the remaining cubicles are not overloaded as a result of the reduction in plant capacity).

Cathode Isolator Operation. This isolator is only a slow-breaking device and must not be withdrawn unless there is at least one other cubicle in parallel to take up the load. With another cubicle or a second rectifier remaining in service there is no appreciable voltage difference across the isolator contacts at the moment of parting so that a simple link can be employed.

Isolating a Cubicle. The cathode isolator is usually located in the centre of the anode fuse panel. This must be withdrawn first, thus diverting the load to the other cubicles after which the six main anode fuses may be withdrawn. The auxiliary circuits are rendered dead by removing the excitation and fan fuses.

All of the equipment above the sub-base compartment is now completely isolated and after the front cover has been replaced to screen the live anode fuse contacts maintenance can be carried out including bulb changing, without any risk to the operators. In some cases the actual positions of the cathode isolator and anode fuses may be different but the operation of the isolation features as described above will still render the bulb compartment safe.

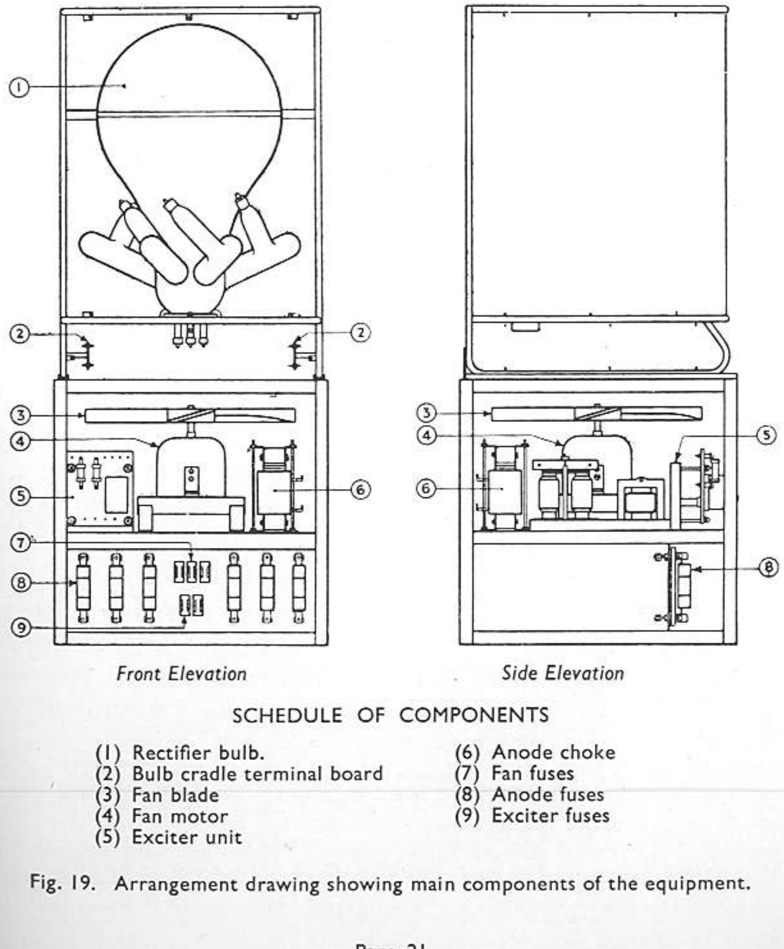
In some equipments the centre contact of the excitation relay is used for alarm or control purposes and it may be necessary to take steps to prevent contact with this live terminal on the exciter unit. Also, according to the manner in which this contact is utilised, steps may require to be taken to maintain operation of the plant or to prevent a continuous alarm being given by the bulb that is out of service.

Restoring to Load. To put the cubicle back into

service replace the exciter and fan fuses, upon which the bulb will strike up and remain running on the exciters. The anode fuses are now inserted and finally the cathode isolator. The bulb will at once pick up load although sharing may not be uniform until its temperature approaches that of those that have remained in service.

If the alarm apparatus has been rendered inoperative for this cubicle it should be remembered to attend to this item at once upon restoring the cubicle to service.

Units designed for operation at voltages of the order



SCHEDULE OF COMPONENTS

(1) Rectifier bulb.
(2) Bulb cradle terminal board
(3) Fan blade
(4) Fan motor
(5) Exciter unit
(6) Anode choke
(7) Fan fuses
(8) Anode fuses
(9) Exciter fuses

Fig. 19. Arrangement drawing showing main components of the equipment.

of 1,500 and above are not fitted with isolation features, the cathode link being bolted in position, as are also the main anode fuses.

Balancers. On three wire systems the neutral wire is obtained by connecting two bulbs in series, any further capacity being provided from bulbs feeding direct into the outers. These latter are referred to as " line " bulbs.

Should it be necessary to isolate a balancer unit the usual precautions must be taken for maintaining the correct voltage to the mid-wire.

GENERAL MAINTENANCE

The general maintenance which it is necessary to carry out on Hewittic Rectifiers is very small. Fig. 19, along with the adjacent schedule, indicates the main components of a standard type ST cubicle.

Exciters. Provided that the exciters operate satisfactorily, no attention need be paid to the exciter relay or any other parts. It will be noted that the relay is enclosed in a dust proof case so that unless a considerable amount of starting of the equipment is called for, only occasional inspection of the contacts is required.

Dusting. The equipment will operate satisfactorily without cleaning or dusting. If dusting is carried out it should be confined to portions beneath the bulb chamber. The dust which settles in the bulb chamber above the fan will in no way impair operation.

Fans. The cubicle fans are driven by totally enclosed low voltage (110 volts) 3 phase induction motors and require no attention other than occasional lubrication. In single-bulb cubicles the fan motors are usually grease lubricated, and the recommended lubricant is Wakefield's Speeroil S. or Aero-Shell No. 4.

When the plant leaves the factory the bearings are packed with grease, and this will suffice for about 3,000 hours of operation. After this period the dust should be carefully removed from around the grease caps and feed

pipes, after which the caps should be removed, filled with the above grease and screwed back again on the feed pipes. This will force a replenishment down to the ball races and will suffice for a further period of about 3,000 hours running.

It is recommended that the motors be taken down after 15,000 to 20,000 running hours and the bearings cleaned out. The old grease can be run out by warming the bearing, followed by swilling in clean paraffin or petrol and draining. The bearing is then repacked with grease and the motor re-assembled. The utmost cleanliness is essential until the overhaul is completed, as any gritty dust finding its way into the grease would cause rapid wear and necessitate early replacement of these precision ground bearings. The types used in these motors are R & M type LJ25 for the upper bearing and LJT17 for the lower.

TRACING FAULTS

The small number of moving parts required in a glass bulb rectifier naturally results in almost complete immunity from faults or interruptions of any sort. But there may come a time when a bulb fails to strike up : the attendant will then require to know the quickest way to locate the trouble and restore the unit to service.

Assuming that all of the phases of the A.C. power supply are alive and of normal voltage (it may be found necessary to check this), the trouble will be found to be one of three things :—

(1) Defective starting relay.
(2) Blown auxiliary fuse.
(3) Defective bulb.

Procedure. The starting relay is unlikely to give any trouble for many years. The contacts are in use only momentarily at the striking up of the bulb and the whole relay is protected by a dust-proof cover. This is transparent, so that the condition of the contacts can be observed without admitting dust from the atmosphere,

etc. No provision is made for adjustment—in fact the screws are sealed, it being considered preferable to replace a defective relay with a new one and return the original one for investigation : (on plants overseas this, of course, may not be practicable).

In the case of a blown auxiliary fuse the cause of such blowing must be investigated before replacing the fuse as it indicates either a defective starting coil or resistor, or a fault on the auxiliary wiring.

(**Warning :** The exciter circuits are connected with the positive busbar of the rectifier : if this is alive from bulbs that are continuing to operate, or from an outside source, the proper precautions must be taken to prevent an accident).

Refer to Figs. 11, 12 and 13, and also the diagram of exciter connections. If the dipper, or starting electrode, pulls into the mercury and remains there it indicates that fuse 4–5 is blown, otherwise the electrode would short circuit the lower starting coil and cause its own release.

The blowing of the cathode fuse will cause the dipper to continually make and break contact with the mercury but there will be no spark and the exciters cannot strike up.

Should the dipper oscillate and produce a whitish spark without the exciters attempting to pick up the arc, the bulb probably has lost its vacuum.

If the bulb operates steadily on its exciters then there will be nothing wrong with the bulb itself, and any difficulty in the way of picking up or sharing load will be the consequence of a defect in the external circuits, such as a blown anode fuse. Check with a voltmeter or detector and replace as required, using only the same type of fuse. Confirm also that the cubicle fan is able to draw an adequate supply of air for cooling the bulbs. It will be observed sometimes that one or more bulbs of a bank of rectifiers is reluctant to pick up load. This is because the available load per bulb is very low and possibly the ambient temperature also is low. When

the demand increases the bulb should start to take its due share of load.

Checking Fan Supply. Where required it is arranged for the speed of the fan to be controlled automatically by the load. This is effected by passing the power feed to the fan through a choke which is magnetised by the load current of the rectifier. This proves a very simple way of controlling the speed of the fan in proportion to the load carried by the rectifier. It does, however, mean that the volts applied to the three fan phases are generally unequal by about 10 per cent. Inequality of the volts at the fan terminals should not, therefore, be regarded as necessarily meaning that a fault has occurred, either in the fan winding, or in the supply. Similarly, there is usually a small unbalance in the current taken by the three phases of the fan. If the fan motor is suspected, it can be checked easily by supplying it from a separate source and taking test measurements in the usual way. The 3 phase auxiliary supply is usually accessible for this purpose.

TESTING FOR LOSS OF VACUUM

The suspected bulb should be removed from its cradle and manipulated so that mercury pours into an exciter pocket at a moderate speed. If the vacuum is unimpaired, this will produce a sharp metallic click, whereas if there is appreciable air in the bulb then it will produce only a dull leaden sound. Further, it may then be possible to trap small bubbles of air in one of these pockets and, if any are seen, there can be no further doubt as to the condition of the bulb.

CARE OF DAMAGED BULBS

As soon as the replacement bulb has been installed in its cubicle the defective one should be placed in the empty bulb case for return to the Works. Even though an arm may be broken off it may be possible to repair it at appreciably less cost than that of a new bulb. For

transport purposes all of the mercury must be in the inverted condensing chamber: if any appreciable quantity is left in an arm further damage could result in the event of rough travelling.

NOTE.—In inverting a large bulb it is imperative that an assistant handles the condensing chamber. As the mercury runs to this end of the bulb the sudden transfer of weight would almost certainly cause a single operative (or even two) at the other end to lose control without such assistance. (See Fig. 5).

EMPTY BULB CASES

Where equipments are supplied for overseas service the bulb cases need not be returned, but one or two should be retained in case it is necessary to return a bulb for repair.

With equipments for installation in the British Isles the bulb cases are supplied on loan and should be returned.

Hewittic Rectifiers

Registered Trade Mark

Issued by

HACKBRIDGE AND HEWITTIC ELECTRIC CO., LTD.
WALTON-ON-THAMES . SURREY . ENGLAND

Telephone : Walton-on-Thames 760 (8 lines)
Telegrams : Electric, Walton-on-Thames

1.5M/5/54 Printed in England

NOTES